26 00 00. ELECTRICAL

26 00 01. SUSTAINABILITY

.1 AE shall reference Division 18 “Sustainability” where some of the requirements are related to this division and adopt applicable requirements into the design.

26 00 03. GENERAL PROVISION

.1 QUALIFICATIONS OF CABLE SPLICERS: Refer to Division 33.

.2 INFORMATION FOR DESIGN OF SYSTEM: During the initial planning conference, consult the University and Facilities Design and Construction, regarding the choice of primary service voltage to be used, its location, and the capacity available. Refer to Division 33 00 03.3.1 for requirements that the Architect/Engineer’s (A/E) Electrical Consultant shall follow.

.2.1 EQUIPMENT AND INSTALLATION GUIDELINES:

.2.1.1 An important aspect of Power System Design and Installation involves consideration of service reliability of the proposed system and loads that are to be supplied. System Installation inspection and Service reliability will be performed by the Contractor in the presence of the Ohio State Energy Partners (OSEP) and Affiliates when and if the Systems are to be connected to University Electrical Power Systems. The System shall not be energized if these requirements are not met, or it fails Final Inspection.

.2.1.2 Contractor(s) and A/E’s electrical consultant(s) are responsible for addressing all the Design review comments to the satisfaction of the university in order to assure the continued reliability of the University Power Distribution System.

.2.1.3 All Electrical floor plans shall include column lines, room numbers, Key Plan, and a north arrow.

.2.2 SAFETY

.2.2.1 The incorrect application of Electricity and unsafe installation can cause both minor and serious accidents. The Designer must remain vigilant to Electrical hazards and take appropriate steps in meeting all safety rules and regulations in Electrical Power and Installation Distribution Design. It is important that the Design meet requirements of the following codes and regulations; NEC, NFPA, OSHA, and National Electrical Safety Code. It is also important that all the Equipment, Devices and Installations supplied and installed in all University’s Facilities meet high level of Safety Requirements, and the Ohio State University Building Design Standards. It shall also be known that the equipment, devices, and installation that fail to meet these requirements will not be accepted.

.3 OVER CURRENT PROTECTION COORDINATION: For any building with an electrical service larger than 1,200 amperes, an analysis of the coordination of over current protection shall be shown on the drawings or provided on a separate document.

.1.1 the coordination study shall show the system by elementary diagram and indicate Arc Flash Coordination Study, Load Flow the available fault current at critical points in the distribution system and the selection of over current devices for time and interrupting capacity coordination. This study shall be part of design services in addition to the ones supplied by the electrical contractor.

.1.2 a copy of the final studies shall be approved by the A/E and uploaded following Ohio State University's Project Closeout Standards with the one-line diagrams and submitted in electronic form in the tool's native format for future use and modification.

.1.3 WEXNER MEDICAL CENTER: For renovations: modification of existing one-line diagrams, panel legends, and short circuit coordination studies to reflect field conditions are required. Existing electronic copies of one-line diagrams and panel legends can be acquired from OSUWMC Engineering.

.4 COORDINATION OF HARDWARE: All electric panel doors shall be equipped with cylinders that accept 7 pin small format interchangeable cores . Refer to Division 08 30 00 for further details.

.5 Equipment belonging to other University Departments shall not be installed in or stored in Facilities Operations and Development mechanical or electrical rooms.

.6 Building electrical service shall be received at medium voltage from Ohio State Energy Partners (OSEP) system or American Electric Power Company (AEP), depending on location and availability.

.7 PROHIBITED MATERIALS AND CONSTRUCTION PRACTICES:

.7.2 Extra-flexible non-labeled conduit:

.7.3 Plastic conduit for interior electrical use, except that PVC conduit may be used for power circuits below basement concrete floors and for ground wires in any location. The transition from PVC to steel shall be made below the floor and shall be galvanized rigid steel conduit.

.7.3.1 Electrical Nonmetallic Tubing (ENT) or "Blue Tube".

.7.4 Steel conduit shall not be used outside unless in concrete. Use aluminum conduit outside and wet locations above grade.

.7.5 Use of aluminum plated bus and aluminum wound transformers is prohibited in all Ohio State University projects.

.7.6 Use of Incompatible Materials: Aluminum fittings and boxes shall not be used with steel conduit. All materials in a raceway system shall be compatible.

.7.7 Power actuated anchors or plug anchorage using wood, lead, or plastic.

.7.8 Multi-use Suspension Systems: Piggyback suspension systems for conduits, fixtures, etc. are prohibited. All suspensions must be hung independently from structure, or, in limited cases, from trapeze suspension systems.

.7.9 Use of wire ties to support conduit.

Exception: Flexible conduit for fixture whips may be supported with UV stable cable ties,

.7.10 Use of wood strips and wood screws to support lighting fixtures.

.7.11 Use of Class J fuses unless permitted otherwise in the Ohio State University Building Design Standards. (Permitted use: Elevator shunt trip fused switches)

.7.12 Direct burial electrical cable at any voltage.

.7.13 Electrical ducts crossing above gas piping.

.7.14 Ducts within 10 feet of a buried steam line in any direction. If it becomes necessary to cross a steam line, acceptable insulation of the crossing must be approved by the Utilities High Voltage Services, Facilities Operations and Development.

.7.15 Hard insulated wire connectors, which have Bakelite or Ceramic insulation, and “push-in” type connectors are prohibited.

.7.16 Not used.

.7.17 Armored cable (BX, AC, etc.)

Exception: MC Cable (Metallic cable with green ground wire) may be used where permitted in the Ohio State University Building Design Standards.

.7.18 Non-metallic sheathed cable.

.7.19 Flat conductor cable type FCC, under carpet, etc.

.7.20 Fluorescent fixtures using 4-foot, 2-foot, U-tubes or compact fluorescent lamps is prohibited.

.7.21 Die cast setscrew and die cast compression type fittings outdoors.

.7.22 Not used.

.7.23 Bottom fed switches, breakers or fuses, unless permitted by the University Engineer.

.7.27 Use of cable tray with primary conductors.

.7.28 Time clock controls used on exterior or security lighting.

.7.29 Use of busway other than as permitted in Section 26 05 33.11.

.7.30 Use of bus way for panel risers.

.7.31 Tapping existing switchgear, switchboards, panelboards, and motor control centers to provide power for new feeders or equipment shall be prohibited in all University facilities.

.7.32 Troffers: Use of radiant ceiling panels.

.7.36 General Duty Safety Switches

.7.37 Custom Built Lighting Fixtures unless permitted by the University Engineer.

.7.38 Recessed step lighting fixtures

7.39 Exterior wall recessed mounted lighting fixtures.

.7.40 Flush mounted in-ground fixtures

.7.41 Exposed wiring of any type in mechanical and/or electrical rooms

.7.42 Top entry in any exterior electrical equipment.

.7.43 Use of Series rated equipment.

.7.44 Vacuum breakers or vacuum switches.

.8 SPECIAL REQUIREMENTS FOR MANHOLES OR VAULTS

.6.1 Manholes shall not be installed inside buildings.

.6.2 If there are existing manholes (MH) or vaults inside buildings undergoing major renovation that cannot be moved or relocated, then provision must be made for access by a live truck, known as the High Voltage Truck, for emergency repair, maintenance, and cable termination or replacement.

26 05 05. ELECTRICAL MATERIALS AND METHODS:

.1 UL LISTED EQUIPMENT AND MATERIALS: Specify only Underwriter's Laboratories (UL) listed equipment, assemblies, and materials when such items are available. The equipment and materials shall be installed in accordance with its listing.

26 05 15. WIRE AND CABLE

.1 MATERIAL: Copper conductors of 98 percent conductivity shall be used unless use is restricted by Government Agencies.

.1.1 Aluminum conductors may be used in new construction for 600 V and below circuit’s 100 amps (#1 AWG) and larger if approved in writing by the

University Engineer and the Maintaining Authority, 225 amps and larger for Medical and Research facilities. Aluminum conductors shall be considered a substitution and shall be submitted in accordance with applicable Division 1 Specification Sections. In existing buildings do not mix conductor material types, do not introduce Aluminum wire into a building which has copper wiring throughout.

.1.1.2. Where permitted, Aluminum conductors shall be Compact stranded per ASTM B-801, AA-8000 series aluminum alloy and shall comply with ASTM B-800; UL 44.

.1.1.3. Aluminum conductors may not be used for feeders to mechanical equipment such as chillers, medical equipment such as MRI, CT, X-ray or similar, generators, or other equipment where the manufacturer requires incoming cables to be Copper.

1.1.4. If Aluminum conductors are used, connectors shall be dual rated CU/ALR, listed by UL for use with Aluminum or copper conductors, and shall be indent type, long barrel with chamfered entry, 2 – hole, compression type for 250Kcmil and above, 1 – hole for less than 250 Kcmil.

.1.1.5 Oxide inhibiting joint compound must be applied on the aluminum conductor for each termination, splice, and tap per the instructions of the cable manufacturer.

.1.1.6 Electrical connectors and terminals shall be tightened according to manufacturer's published torque-tightening values or those specified in UL 486A.

.1.1.7 Provide infrared scan reports with pictures of all items tested and pictures of repairs 11 months after University move-in. Repairs responsibility of installing contractor.

.1.1.8 Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate Aluminum cable. Cable splicer shall have a minimum of 2000 hours experience with terminating and installing Aluminum cable. Furnish satisfactory proof of such experience for each employee who splices or terminates the cables. Persons listed by the Contractor may be required to perform a dummy or practice splice and termination in the presence of a University representative or Engineer before being approved as a qualified installer of aluminum cables.

.2 SECONDARY CONDUCTORS:

.2.1 COLOR CODING for new construction

Color-coding for 480/277V and 208Y/120V shall be as follows:

Phase	Voltage - 208Y/120	Voltage - 480Y/277

Neutral stripe)	White/Gray	White or Gray (identifiable colored
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Ground	Green	Green w/ Yellow stripe

.2.1.1. For existing buildings, maintain existing color code.

.2.2 Solid and Stranded Wire: No. 12 AWG and smaller may be solid. No. 10 and larger shall be stranded.

.2.3 Minimum size for lighting and power branch circuits: No. 12 AWG.

.2.3.1 Use No. 14 AWG stranded for control wiring between control panels and motor starters.

.2.4 Not used.

.2.5 Field installed cords to portable equipment shall be type ST or G and Field installed cords for normal Equipment shall be type SRDT containing identified equipment.

.2.6 Circuit wiring through LED fixtures shall be 600-volt 90-degrees C insulation. Fixture must be approved for through wiring, if thus used.

.2.7 General use insulation: NEC, 600-volt type THHN/THWN or XHHW.

.2.8 Connections in No. 10 and smaller wire shall be made with threaded-on plastic or nylon insulated wire nuts. Crimp connectors, except butt connectors, are prohibited. Joints in No. 8 and larger conductors shall be made with pressure type mechanical or split bolt connectors insulated with plastic electrical tape.

2.9 MC Cable may not be used in the following applications unless approved in writing by the University Engineer:

Exposed conditions, in mechanical and electrical rooms, kitchens, science laboratories, utility spaces or medical facilities. MC shall also not be run exposed below eight feet above finish floor.

Run in corridors ceiling spaces.

Exception: MC Cable may be used as fixture whips for lighting fixtures provided MC Cable longer than 6’ shall be properly supported.

Exception: MC Cable may be used in existing walls.

.2.10 MC Cable may be used for branch circuiting in offices, pool classrooms, and corridors of office and classroom buildings provided it is supported properly and run taut.

.2.11 Not used.

.2.12 **WEXNER MEDICAL CENTER:** Medical Grade MC may be used for "Normal" side branch circuits in patient rooms where permitted by Code. MC cable for use in patient care areas, for normal power branch circuits only, shall include an insulated green ground conductor and a full size aluminum bonding/grounding conductor in combination with the exterior armor. MCI-A listed connectors required.

.2.13 "Homeruns" back to panels are not permitted to be MC Cable; EMT or rigid conduit shall be used.

.3 WIRE AND CABLE IDENTIFICATION

.3.1 See **Wexner Medical Center** Special Requirements in 26 05 53.

26 05 17. WIRING DEVICES

.1 DESIGN: All wiring devices provided shall be Heavy Duty specification grade. New building devices will be ~~ivory~~ white with stainless steel plates for standard and ground fault interrupter use on normal power. Isolated ground devices shall be orange with stainless steel coverplates. Wiring devices on emergency power shall be red with stainless steel coverplates. In existing buildings, designers shall match existing color scheme that is prevalent throughout building with the exception of emergency power. All emergency power receptacles added to existing buildings shall be red.

.1.1 **WEXNER MEDICAL CENTER**: Hospital grade devices required in patient care areas.

.1.2 Placement of Receptacles:

.1.2.1 In standard size classrooms (49 students or less) provide a double duplex receptacle at the front of the classroom centered under the chalkboard. Provide two additional receptacles at the front of the room spaced half way between corners and double duplex receptacles. Back of rooms to be provided with single duplex receptacle at center of wall and two additional receptacles equally spaced from corners. Remaining walls to be provided with two duplex receptacles on each wall equally spaced.

.1.1.2 Classrooms (50 students +) Provide two duplex receptacles for the front wall, centered between the corners and double duplex receptacle at the center of the wall. Provide two duplex receptacles equally spaced on all remaining walls.

.1.1.3 Corridors shall be provided with duplex receptacles 35' on center and a maximum of 15' from end of corridor. These receptacles shall have separate circuits and shall not be fed from the adjacent room circuits.

.1.1.4 Lecture halls shall be provided with a double duplex receptacle centered on the front wall and two additional double duplex receptacles equally spaced between center double duplex and corners. Provide duplex receptacle in floor for podium. Provide additional receptacles throughout for cleaning. These receptacles shall be a maximum of 25' on center. If lecture hall is provided with a lab bench, than provide bench with double duplex for every eight-foot of bench.

.1.1.5 Computer Labs shall be provided with at least two general-purpose receptacles equally spaced per wall in addition to all receptacles for computers. These general purpose receptacles shall not be wired

.1.1.6 Mechanical room shall be provided with at least four duplex receptacles (one per wall) and additional duplex receptacle where walls are 25' or longer.

.1.1.7 Offices: Provide a minimum of one duplex receptacle per wall.

.1.1.8 In utility tunnels receptacles shall be placed a maximum of 100' on center and a maximum of 25' from the entrance, exit or intersection of tunnel. These shall be GFCI type in NEMA 3R enclosures. These shall be located on the ceiling in line with the nearest light fixture.

.1.1.9 In pedestrian tunnels, receptacles shall be a maximum of 100' on center and a maximum of 25' from entrance and/or exit. Receptacles shall be GFCI type and mounted 48" above the finished floor to the top of the receptacle with spring-loaded cover.

.1.1.10 Receptacles shall be mounted with the ground pin "UP".

.1.1.11 Tamperproof receptacles shall be applied in accordance with the currently adopted edition of the National Electrical Code.

.1.1.12 Workstations shall be provided with a double duplex receptacle installation.

.1.2 Switches

.1.2.1 Switches provided for all uses shall be specification grade. Color scheme shall match receptacles.

.1.2.2 Switches provided at roof hatches or where provided outside of rooms they are serving shall be provided with pilot lights not lit handles.

.1.3 Coverplates

.1.3.1 Generally coverplates for flush-mounted standard devices shall be stainless steel for interior use in new buildings. Where work is being performed in existing buildings coverplates shall match the majority of the existing devices.

.1.3.2 Coverplates for exterior use shall be type, which allow NEMA 3R rating to remain while in use. Where exterior device could be exposed to vandalism, provide locking type coverplates.

.1.4 **WEXNER MEDICAL CENTER**: Wiring Devices

.1.4.1 Receptacles located in acute care, clinical or procedural buildings shall be hospital grade. Receptacles located in public areas (e.g., waiting rooms, lobbies, corridors, etc.) shall be tamper-resistant.

.1.4.2 Patient care areas shall be tested (and documentation provided) for conformance to NFPA 99 Electrical Systems Performance Criteria and Testing.

.1.4.3 Coverplates for flush-mounted standard devices shall be stainless steel only.

.1.4.4 Provide all device plates with labeling indicating panel and circuit number on the outside of the cover plate in accordance with Medical Center Special Requirements in 26 05 53.

26 05 19 MULTI-OUTLET STRIPS

.1 Multi-outlet strips for power or data and/or communications shall be two piece single channel steel capable of accepting full size heavy duty specification grade devices. It shall be provided with a standard white finish

.1.1 Minimum dimensions of single channel multi-outlet strip shall be 1.26” X 2.75”.

.2 Multi-outlet strip for both power and data and/or communications shall be two piece channel multiple channel to keep power separated from data/and/or communications wiring.

.2.1 Minimum dimensions of two channel multi-outlet strip shall be 1.75” X 4.75”.

.3 Multi-outlet strips may be provided at laboratory benches, work benches and work counters in offices.

.3.1 Multi-outlet strips shall not be run through walls, fire rated or otherwise.

Commentary: *Consider including duplex receptacles with USB ports where appropriate.*

3.2 Provide the University with 10% spare parts including but not limited to coverplates, elbows, entrance and end fittings, tees, utility boxes, etc.

26 05 29. HANGERS AND SUPPORTS

.1 MATERIALS FOR STRAPS AND HANGERS: Heavy-duty malleable iron or steel. For installation in locations above grade that are subject to moisture penetration, specify corrosion-resisting steel. Perforated straps are not acceptable.

.2 INDEPENDENT SUPPORT SYSTEMS: Required for all installations, except that light weight lighting fixtures on, or recessed into, suspended ceilings may have adjustable bar strap supports carried on the ceiling suspension system.

.2.1 Surface outlet boxes, to which fixtures are attached, and pull boxes, shall be fastened to the structure independent of the conduit system supports.

.2.2 Conduits above suspended ceiling shall be attached to the structure and shall not be supported by a ceiling suspension system

.3 COORDINATION WITH GENERAL CONSTRUCTION: The A/E shall include the following (or similar) statements in specifications for suspended lay-in ceilings:

.3.1 Surface mounted LED lighting fixtures shall be supported from the structure above independent of any ceiling system by use of 3/8 inch all thread rods.

.3.2 Flush or recessed fixtures in ceilings of the suspended lay-in type shall be installed so that the long dimension of the fixture is supported on the main support member of the ceiling system. Provide at least two galvanized steel safety hangar wires or safety chains, attached from the fixture housing to the structure independent of the ceiling system. Wire or chain shall withstand a 3-foot, 50-pound drop test.

26 05 33.10 INTERIOR CONDUIT AND FITTINGS: Minimum conduit size for power, lighting, and control circuits shall be 3/4-inch.

.1 RIGID GALVANIZED THREADED UL LABELED CONDUIT shall be specified for use in exterior walls, outdoors, for indoors exposed (surface) applications from floor level to 8-feet above floor, seal penetrations, and all the areas having potential to corrode or eat away by chemical-action (corrosive atmosphere) and hazardous locations.

.1.1 Threaded couplings shall be used with rigid conduit ~~and I.M.C~~.

.2 UL LABELED, GALVANIZED STEEL EMT up to 4-inch trade size may be used in interior partitions, above ceilings, and for surface applications, except in mechanical and electrical rooms and shop spaces where it may be used 8’-0” from the finished floor. In corrosive and hazardous locations, use fiberglass conduit.

.2.1 Insulating bushings and/or insulated throat fittings shall be used throughout EMT installations.

.2.2 Compression fittings shall be used exposed below eight feet from finished floors. Setscrew type fittings may be used in all other applications, including WEXNER MEDICAL CENTER (indoors).

Exception: Setscrew fittings may be used below eight feet if bolts are not pointing outward.

.3 PLASTIC JACKETED RIGID STEEL CONDUIT shall be used in corrosive atmosphere.

.4 FLEXIBLE CONDUIT used for motor make up and lighting fixture connections. Minimum size: 1/2-inch for lighting fixture whips and ¾" for motor connections; maximum length: 6 feet 0 inches. Flexible conduit of any type shall not be used in interior partitions or in walls as a substitute for EMT, IMC or rigid steel conduit. A ground wire shall be pulled in all flexible conduit.

.4.1 Plastic jacket shall be used on flexible conduit exposed to outdoor or moist locations.

.4.2 Liquid-tight flexible metal conduit may be used in raised floor computer room applications.

.5 RIGID ALUMINUM CONDUIT shall be used outdoors**,** above grade, in damp locations and may be used in other locations in place of rigid steel conduit where corrosion is not a problem.

.6 Conduit installed through a building wall shall have internal and external seals. Specify Link-seal or equivalent.

.7 Elbows used for medium voltage cable shall be long radius rigid steel or if above grade, outside, rigid aluminum.

.8 GROUNDING: Conduit crossing building expansion joints shall have expansion provision with grounding continuity.

26 05 33.11 BUSWAYS:

.1 In general, use of Busway is discouraged. Any proposed use shall be reviewed with FOD during the schematic design phase.

.2 The A/E shall not use Feeder Busways in lieu of conduit and wire except for short distances inside substation rooms. Maximum length shall be 10 feet.

.3 PLUG-IN BUS shall be used in shops where the load density provides an economic advantage over panels and shall not extend into more than one space. Plug-in bus shall be copper. Busway shall be used to serve one room or usable space. It is prohibited for busway to penetrate a fire rated wall**.** Provide two spare bus plugs of each size installed.

.4 INDOOR BUSWAY (if used) shall be water resistant per ANSI/IEEE Standard 141-1986.

.4.1 If use of busway is approved by special permission for a project, Contractor shall provide 50 feet of spare busway and 10% of total switches used. It includes when busway is installed in shop areas or specially approved conditions.

.4.1.1 For use in straight, accessible runs only.

.4.1.2 Not acceptable for use in emergency power systems.

26 05 33.12 SURFACE RACEWAYS

.1 The A/E shall specify Surface Raceway / Metallic Raceway with associated coupling, boxes and fitting to be mounted to the surface of structure for the installation of Electrical Conductors. It shall be used in the following locations:

.1.1 In dry locations.

.1.2 Where permitted in Class I, Division 2 Hazardous (Classified) locations by the National Electrical Code (NEC).

.2 FITTINGS AND BOXES

.2.1 Raceway shall have manufacturer's finish standard prime coating suitable for field painting.

.2.2 Surface Metallic Raceway. Metallic surface raceway shall be one piece construction, manufactured of .040" steel with smooth finish manufacturer's standard color. Minimum size to be ¾" X 21/32".

.2.3 Surface Metallic Raceway shall be used in dry locations, extensions through walls, and shall be permitted to pass through drywall partitions and dry walls only if the length going or passing through is not broken. It is required that access to the conductors shall be maintained on both sides of the walls, partition and floor.

.2.3.1 The surface metallic raceway shall not be used where concealed, except as permitted by NEC. The use shall be limited to Class 2 power limited applications and communication.

26 05 33.13 UTILITY TUNNEL CONDUIT AND FITTINGS

.1 INSTALLATION REQUIREMENT for corrosive and external heat generating environment.

The conduit must be suitable for the best protection from corrosion in the most demanding environments such as utility tunnels, under bridges, chemical, utility plants, underground pipeline, laboratories, electrical substations, and parking lots.

The conduits and the fittings must meet the requirements of UL 1684 that covers conduit type AG for use above ground and/or below ground, and type BG for use below ground applications. The University requires that the Manufacturer supply a letter from UL, not a "Certificate of Compliance," for the product to be approved for use in University facilities.

.1.1 The preferred conduit and fittings shall be fiberglass reinforced epoxy manufactured using the filament process. The optional conduit shall be PVC coated rigid conduit that provides maximum protection against corrosion where fiberglass conduit usage is extremely difficult.

.1.2 FIBERGLASS CONDUIT AND FITTINGS

The Fiberglass Conduit and Fittings Standards cover the application Installation, and use of associated Fittings. The primary intent is to incorporate changes in technology and incorporate products that were not Proven or existing when earlier versions of the Ohio State University Building Design Standards were published.

All Fiberglass Conduits shall be listed by Underwriters Laboratory, UL Std., and UL 1684.

1.2.1 The materials made or manufactured for use as conduits, raceways, boxes, cabinets equipment enclosures, and the finished product (Fiber conduits) shall conform to the latest edition of NFPA 130, NFPA 502,NFPA 70(NAC) and shall have capability to withstand high temperatures up to 500 degrees C or (– 60 + 932 degrees F) for minimum of one hour. The Fiberglass conduits requirements of the Standards shall include the followings:

A. High Temperature Combustion Resistance.

B. Low Smoke Zero Halogen.

C. High Mechanical Strength.

D. High Dimensional Stability.

E. High Chemical Resistance.

F. No impact from Stray currents.

1.2.2 The A/E shall make certain that the type of Fiberglass conduits specified are manufactured from epoxy resins that had flame resistance and low smoke characteristics, zero halogen and meeting the requirements of section 26 05 33 1.2-to-.1.2.1 of this Standard

1.2.3 The fiberglass conduit shall be available in diameters ¾” to 6” and shall be UL Listed for use above and underground.

Again, the resin system shall be epoxy based using a hydride curing agent. The permitted fiberglass shall possess continuous E-glass roving. All additives for increasing flame spread and lowering smoke density must be halogen free (i.e. must not contain chloride or bromine).

The permitted type shall use carbon black as ultra violet inhibitor to protect the conduit and fittings during storage and if or when it is exposed outside.

.1.3 FITTINGS AND ACCESSORIES

All fittings, elbows, and accessories shall be manufactured from the same process, using the same methods and chemicals as the pipe. The exceptions are plastic duct plugs and access fittings (often referred to as non-dalet fittings). Access fittings shall be made from fire retardant vinylester materials, halogen free, must be hot compression molded and shall have couplings attached to the body of the access fittings.

.1.3.1 The use of Fiberglass conduit shall be permitted for both below and above ground if requirements of Section .1.2.2 of this Standard is met:

A. Tunnels

B. In Class 1 Division 2 Installation(For Class 1 and Div2 Application "XW" fiberglass Conduit shall be used meeting the requirements of section 501.10(B) of National Electric Code, and UL 1684A Listed for above Ground use)

C. Under Bridge Applications

D. Plenum Areas

E. High Temperature Applications.

.1.3.2 Cement for PVC conduit and fittings shall be as recommended by the PVC class 1 div 2 conduit manufacturer

.1.4 OPTIONAL PVC COATED RIGID METAL CONDUIT

.1.4.1 The PVC coated conduit must be UL listed. The permitted PVC coating must have been tested and approved by UL as providing the primary corrosion protection for the rigid metal conduit.

.1.4.2 Applicable UL Standards may include: UL 6 Standard for safety, Rigid Metal Conduit, UL 514B Standard for Safety; Fittings for conduit and outlet boxes.

.1.4.3 The PVC coated galvanized rigid conduit must be ETL Verified to the Intertek ETL SEMKO High Temperature H_2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

26 05 35. RACEWAYS:

.1 For conduit/raceways penetrating walls separating pressure or large temperature differentials, provide packing within conduit/raceway at nearest j-box within the room to prevent the transmission of air between the spaces.

26 05 45. UNDERGROUND RACEWAYS:

.1 GENERAL REQUIREMENTS: All underground cables of any classification shall be installed in raceway systems. Raceways for street lighting shall be 2" minimum. All other applications shall be sized in accordance with the projected electrical load growth in the vicinity but not less than 1.5". For conduit requirements in utility tunnels and under bridges Refer to Division 33.

26 05 53. LABELING AND IDENTIFICATION

.1 RACEWAY COLOR CODE:

Wexner Medical Center: Color Coding shall be as follows for new construction:

SYSTEM COLOR

Pwr Normal- Black

Pwr Emergency Equipment- Purple

Pwr Emergency Life-Safety- Brown

Pwr Emergency Critical- Yellow

Fire Alarm- Red

Nurse Call- Green

IS (TV, Data, FO)- Orange

Building Automation- White

UPS power- Blue

Clock- Pink

TV- none

PA- none

1.1 Conduits: Dot marking at each end of run and at minimum 10' intervals. Paint dot prior to installation of conduit. Conduit fittings shall match system color.

1.2 Boxes: Dot marking. Paint dot prior to installation of box. Marking of covers is not an acceptable method of providing marking of boxes. Device boxes shall match system color.

1.3 For existing buildings maintain existing color code.

.2 NAMEPLATES

Nameplates shall be labeled per the following color-coding chart:

SYSTEM	PLATE COLOR	LETTER COLOR
Normal	Black	White
Emergency-Equipment	Red	White
Emergency-Life Safety	Red	White
Emergency-Critical/Standby	Red	White
UPS	Blue	White

.2.1 Material for nameplates shall be laminated plastic.

.2.2 Fasteners for nameplates shall be stainless steel sheet metal screws. Small nameplate shall be fasted at each end. Large nameplate shall be fastened at each corner.

.2.3 Lettering: Small nameplate – 1/8” minimum. Large nameplate – 1/4" minimum. All upper case letters.

.2.4 Size: All nameplates for the same type of item shall be the same size. All sub-nameplates for an item shall be the same size.

.2.5 Items that shall be provided a nameplate:

SMALL NAMEPLATE	LARGE NAMEPLATE
Disconnects	Sub-Stations
Starters	Switchgears
Combination Disconnect/Starters	Switchboards
OPD’s (except in branch panelboards)	Panelboards
Motors	Motor Control Centers
Electrical Equipment (except large nameplate equipment)	Gen Sets

Systems Panels	Transfer Switches
	Transformers Elevator Panels Motorized Equipment UPS Units

.2.6 Provide typed list of nameplates for approval.

.2.7 **Wexner Medical Center:** Typical (not an all-inclusive list) nameplates follow. Maintain existing building nomenclature for renovations. For new construction use building number for "Building" nomenclature.

BUILDING	BRANCH	EQUIPMENT	VOLTAGE
Brain and Spine -BSH			
Central Plant –C	Critical – C	Distribution PnlBd – D	208/120 or 240/120- L
	Equipment – E	Gen Set – G	480/277 – H
Davis – DA	Life Safety – L	Motor Control Ctr – M	
Doan – D	Normal – N	Switchboard – B	
Dodd – DO		Switchgear – S	
Heart – H		Transfer Switch – T	
James – CC		Transformer – X	
		Unit Sub-Station – U	
		Panelboard - Blank	
Harding/Neuro – N			
Rhodes – R			

Example: BRANCH PANELBOARD

D-3-H-L-5

D: Building

3: Floor

H: Voltage

L: Branch

5: Sequential Number

26 10 00. SECONDARY/LOW VOLTAGE ELECTRICAL DISTRIBUTION

.1 MAGNETIC INTERFERENCE AND MITIGATION

Magnetic Interference can pose major problems in the Design and Operation of Electrical and Electronic Equipment, Instruments, Control Systems, Data processing equipment and communication networks. This equipment frequently indicates aberrations whose sources may not be readily recognized, but which are due to magnetic interference. In general, such interference is classified as internal and external.

A. Internal Interference, created by Operation of Components within the system itself, can usually be eliminated or nullified by shielding the individual components and confirming the magnetic force they create.

B. External Interference is frequently caused by nearby or adjacent equipment such as transformers, medium voltage busway, or switching equipment, which generate magnetic “spikes” affecting apparatus that is not physically attached to the source of interference.

.1.1 Not used

.1.2 Not used

.1.3 The A/E shall engage the services of an experienced shielding consultant to prepare a report detailing the project shielding requirements and specifications.

.1.4 A/E’s shielding consultant(s) shall contact the University Engineer for details, if there should be any questions.

.2 TRANSFORMERS - UNDER 600 VOLTS

.2.1 General-purpose distributing transformers shall be single-phase and three-phase dry-type which are generally used with primaries connected to secondary distribution circuits. They shall be designed for the voltages of 120, 208, 240, 480, and 600 with ratings ranging from 500VA to 500KVA and frequency of 60Hz.

.2.2 the transformers shall be designed for continuous operation at the rated KVA for 24 hours a day, 365 days a year operation with a nominal life expectancy and greater overload capabilities in accordance with the latest ANSI-C57 and shall comply with DOE 2016 requirements. The temperature rise of these transformers shall be 115 degrees C temperature rise over a 40 degree ambient and shall be insulated with a UL recognized 220 degree C insulation system. Transformers shall have a minimum K factor rating of 4 as recommended by ANSI/IEEE C57.110 - 2018, where required (i.e. computer center, lab, etc.).

Commentary: *Continuous overload capacity is not designed into transformers because the objective is to be within the allowable winding temperature rise with nameplate loading*.

.2.3 The transformers shall be designed for a low coil watt loss.

.2.4 Coil and Core Assemblies

.2.4.1 Transformer cores shall be constructed with high grade, non-aging, grain-oriented silicon steel with high magnetic permeability, low hysteresis and eddy current losses.

.2.4.2 Transformer coils shall be wound of electrical grade copper and continuous wound construction. The neutral conductor shall be rated to carry 200% normal phase current, when required.

.2.4.3 Enclosure shall be ventilated, heavy gauge sheet steel primed and finished in gray baked enamel. The core and coil assembly of the transformers shall be impregnated with non-hygroscopic, thermosetting varnish and cure to minimize hot spots and seal out moisture. The core of the transformer shall be grounded to the enclosure.

.2.4.4 The sound levels of the transformer shall be designed in accordance with ANSI/NEMA recommended levels.

.2.4.5 Provide minimum clear working space of 3 feet (36”) in front of transformers operating at 600 volts, nominal, or less to permit ready and safe operation adjustment, repair and maintenance; minimum 6 inches on sides and rear.

.2.5 Transformers greater than 25 KVA shall not be mounted on or near the wall adjacent to an office, computer room or laboratory unless the wall is magnetically shielded.

26 20 00. LOW-VOLTAGE ELECTRICAL TRANSMISSION

.1 EMERGENCY SERVICE: Refer to Section 26 30 10.

26 20 03. LOW-VOLTAGE SWITCHGEAR – SERVICE ENTRANCE

.1 PROTECTIVE DEVICES: Main breakers and feeder breakers or switches shall be equipped with ground fault protection as required by applicable codes. In critical applications provide coordinated ground fault protection on feeder breakers. Provide settings and coordination information with the service manuals.

.1.1 Where applicable the following warning sign shall be provided:

WARNING: SHUTTING OFF MAIN SWITCH DOES NOT SHUT-OFF POWER IN ENTIRE BUILDING.

Provide the following additional information as applicable:

A ADDITIONAL MAIN SWITCH IS LOCATED IN ROOM O30M IN THIS BUILDING

B. AUTOMATIC TRANSFER SWITCH LOCATED IN ROOM 530M IN THIS BUILDING AND EMERGENCY GENERATOR IS LOCATED IN ROOM O36M OF MATH TOWER.

Include building and room number if emergency source is not in the same building as the main switch.

.1.2 All circuit breakers with solid state trip units shall comply with the following standards:

.1.2.1 ANSI/IEEE C37.90.1 – Surge Withstand Capability (SWC)

.1.2.2 ANSI/IEEE C37.90.2 – Withstand Capability of relay systems to Radiated Electromagnetic Interference from transceivers.

.2 Operating handle/mechanism shall be rated for 10,000 mechanical endurance operations.

.3 All switches shall be top or horizontal fed to the breakers.

.4 Indicator lamps shall be LED type utilizing low voltage lamps.

.5 Provide substation interface pull box(es) in substation room to allow for connection to low voltage monitoring systems for breaker information, metering information and any other low voltage contacts (e.g., maintenance switch position indication) as defined below.

.6 The breaker manufacturer defined communications (BACnet communication protocol if available) bus shall be extended from main and feeder breaker trip units to an externally mounted hinged pull box containing a manufacturer provided gateway (if needed, e.g., Modbus to BACnet) for conversion to BACnet protocol. System communication shall be configured for monitoring purposes only. Coordinate and provide connection to BAS system via Ethernet or MSTP to nearest building controller.

.7 Main breakers shall be equipped with manual override of instantaneous trip unit settings in order to provide acceptable arc flash levels for maintenance work. Manual override position indication shall be monitored by building automation system.

.8 Substation feeder breakers shall not be less than 10% of the rating of the main and tie circuit breaker ratings.

26 20 04. METERING: Refer to Division 33

26 20 05. SERVICE DISCONNECTS:

.1 Secondary main disconnects shall be equipped with electronic trip devices.

.1.1 The analysis diagram fault currents shall be shown on a symmetrical basis; and for calculation purposes, the transformer primary available fault supply shall be considered as unlimited.

.2 Use of FUSES in new construction is discouraged. FUSES may continue to be used in existing primary-voltage services, secondary-voltage main switchgear, distribution panelboards, and motor controls.

.2.1 UL classification fuses shall be used as required for time delay and current limitation requirements of the application.

.2.2 Class J fuse is prohibited with the exception of elevator power modules. Use class RK1, 200,000 AIC rated fuses for up to 600 amp applications and RK1 for maximum short circuit protection.

.2.3 Fuses for secondary service mains and feeders over 600-ampere shall be UL Class L.

.2.4 Spare Fuses: Specify that a spare fuse complement be stored on existing metal shelves, metal mounting boards, or in a cabinet in the electrical switchgear room and that a typewritten and framed bill of material is mounted nearby. If there is no existing storage or additional storage space is required, specify that Contractor provide a cabinet equal to Bussmann SFC and provide hardware to accept BEST 7 pin interchangeable lock cores.

.2.4.1 Spare fuse complement shall include a minimum of three or 10% of the total each (whichever number is greater) spare fuses of each class, ampere, and voltage rating installed, including primary fuses and control circuit fuses in switchgear and any equipment.

.2.4.2 Provide two fuse pullers for every size fuse and voltage rating.

26 20 06. GROUNDING SYSTEM:

.1 DRAWINGS AND SPECIFICATIONS: Drawings shall show ground systems, protective conduit sizes, and relative locations. Specifications and drawings shall include detailed requirements of the grounding system. A reference only to the National Electrical Code, without elaboration, has proven to be insufficient. Specifying requirements only by referencing the National Electrical Code is prohibited. It is required that the A/E shall specify all requirements applicable, instead of referring only to National Electrical Code. All sensitive electronic equipment (computer rooms, etc.) shall have single point grounding system.

All connections to the grounding system shall be clamped, exothermic welded, cad weld or equivalent. It is required that the grounding system be tested and have a resistance reading of less than 3 ohms at the ground level. Only copper to copper may be clamped. The A/E shall calculate the system required to obtain 3 ohms. The contractor shall only be required to install the indicated system.

.2 SERVICE GROUND: Grounding rods shall be a minimum size of ¾" x 10' copper clad steel and shall not be placed in back-fill. It shall meet current NEC requirements and other applicable codes.

.2.1 Interconnection of the service ground, system neutral, and equipment ground conductors shall be made within the service equipment.

.2.2 Grounding path through feeder conduits must be kept at less than five ohms resistance. The entire feeder conduit shall include a grounding conductor. The equipment enclosure (transformer case, etc.) shall not be used as a grounding path.

.2.3 Grounding conductors shall be 600-volt insulated installed in rigid PVC or rigid galvanized conduit. No metal parts such, as locknuts shall surround the ground conductor. If metal is used, protective conduits for ground conductors shall be bonded at both ends to reduce impedance in the ground path under fault current flow. All conduit connections shall be threaded.

.2.4 A/E shall require electrical contractor to provide resistance testing. Testing shall be witnessed by the A/E and the university project manager. Test results shall be recorded on contractor's letterhead and submitted as part of the Operation and Maintenance Manuals.

.2.5 **WEXNER MEDICAL CENTER**: REFERENCE GROUND POINT: Operating Rooms, procedural rooms, invasive procedure areas that equipotential grounding between multiple sources or grounded equipment and surfaces shall have a reference ground point located within the respective room. The reference ground shall consist of a copper bus mounted inside a dedicated, acceptable enclosure. Utilizing a local power panel ground bus for this purpose is not acceptable.

.2.6 **WEXNER MEDICAL CENTER**: BUILDING GROUND REFERENCE SYSTEM: Shall consist of an exposed copper bus located in mechanical rooms containing transformers on each floor (one per floor minimum). Grounding system riser drawing detail is required on the construction documents.

.3 TRANSFORMER GROUNDS:

.3.1 Building Service Transformers: Secondary neutrals shall be grounded separately from the neutral ground at the service main, unless close coupled in unit substation construction.

.3.2 Low Voltage Transformers: Secondary neutrals shall be grounded in the low-voltage service equipment, as required by NEC for services and all available grounding electrodes. (Building steel, etc.)

.4 EQUIPMENT GROUNDS: A wire equipment ground shall be installed within the branch circuit conduit and be grounded to the cabinet of the panelboard to a non-

insulated ground bus. The neutral bar of the panel shall not be used for equipment grounds.

.4.1 Equipment grounds and the identified neutral shall not be electrically interconnected on the building side of the service ground.

.5 CONVENIENCE OUTLETS: Specify that a wired ground be provided for continuity of ground path from the device-grounding pole. Provide ground fault interrupter outlets in wet conditions and where required by NEC and other related codes.

.6 EXTERIOR LIGHTING POLE: For steel-framed structure, explore a concrete-encased reinforcing bar electrode. A steel rod similar to the reinforcing bar shall be used to join, by welding, a main vertical reinforcing bar to an anchor bolt. The bolt shall be permanently connected to the base plate of the steel column supported on that footing. The Electrical System may then be connected for grounding to the building frame by welding or by a bronze bolt tapped into a structural member of that frame. For Electrical Systems grounding, specify that a supplemental ground rod ~~or~~ and ground copper wire are provided for equipment grounding at each light fixture. All underground PVC conduits to the light poles shall contain a dedicated ground copper wire in combination with equipment grounding. It shall be designed to provide a safe method of protecting electric distribution systems by causing the overcurrent or ground fault protective equipment at the source panelboard to disconnect the circuit in case of ground fault.

26 27 00. LOW-VOLTAGE DISTRIBUTION EQUIPMENT

26 27 03. DISTRIBUTION:

.1 DESIGN: If feasible, the secondary main breaker shall be made a part of the building distribution switchgear or switchboard. In no case shall the switchgear or switchboard or panelboard be directly attached to the transformer. A minimum 12-inch space with solid barrier is required to reduce the transfer of transformer heat to the low voltage section. Reduction of heat transfer may be accomplished with secondary throat or ventilated transition section.

.1.1 All Switchgear with “Main-Tie-Main” arrangement shall have trapped key interlocks per ANSI/ASSE Z244.1-2003 to prevent paralleling two electrical sources. The testing, phasing, and startup of dual fed switchgear shall be under the supervision of OSEP Utilities High Voltage Services.

.2 EQUIPMENT: Metal-Enclosed switchgear (UL 1558 construction above 1600A) or distribution switchboards (UL891 construction 1600A and less) shall be used in buildings or University Facilities at 600V and below for Service Entrance Power, lighting distribution and as the secondary sections of Unit Substations. The following components shall be specified as required:

A. Surge Protective Device SPD. ~~Service Protectors~~

B. Molded Case circuit breakers, group mounted, less than 800A, individual mounted 800A and above.

C. Fusible switches (existing buildings only)

D. Motor Starters

E. Low Voltage AC Power circuit breaker (generally limited to main or tie position)

F. Not used.

G. Transfer devices or switches

H. Instrumentation and metering

I. UL Service Entrance Label.

.2.1 Type of Molded Case Circuit Breakers: These devices are available in the following general types: Thermal-Magnetic, Adjustable, instantaneous trip, and Electronic Trip (250 A and above) . It is required that all circuit breakers that are equipped with electronic trip unit must comply with Section 26 20 03.1 of this Standard.

.2.1.1 Air circuit breakers shall be draw out type, installed in individual compartments.

.2.1.1.1 Air circuit breakers and molded case breakers shall be fully rated to interrupt the available short circuit current.

.2.2 Operating handle/mechanism shall be rated for 10,000 mechanical endurance operations.

.3 PROVISIONS FOR ADDITIONAL CIRCUITS:

.3.1 Size of Switchgear or switchboard: Select a size that will provide sufficient spare spaces, complete with bus and hardware, for a reasonable forecast of future installation of circuits. Provide the following spare devices at the design stage:

For Fusible Switchboards	For Circuit Breaker Switchboards
(Existing buildings only)	
Four 30 amp/ 3 poles	Ten 100 amp/3pole*
Four 60 amp /3 poles	One 225 amp 3/pole*
Two 100 amp / 3 poles	
One 200 amp /3 poles	
	*with adjustable trips

.3.2 Additional Section: Provide space and the bus arrangement for the addition of future switchgear or switchboard sections.

.4 INSTRUMENTATION shall be per section 26 20 04. Metering.

.5 SERVICE TO FIRE PUMPS: Fire pumps shall be served and protected as required in NFPA 20 and NFPA 70.

.6 Use circuit breaker type switchboard instead of panelboard for emergency systems for the purpose of future growth and expansion. The switchboard shall be equipped with metering systems as required in Division 33 of this Standard.

.7 When adding switches, circuit breakers, bus plugs or motor starters to existing equipment, the A/E shall include the following on the design documents:

.7.1 The manufacturers' nameplate data including manufacturer, catalog information and order number of the existing equipment.

.7.2 If the equipment is no longer being manufactured (i.e., Continental, Arrow Hart, Crouse Hinds, etc.) the A/E will contact a company that specializes in obsolete equipment and obtain information about availability of equipment and mounting for the bidding of the project.

.7.3 The A/E will provide appropriate staff and equipment during the design phase to open equipment to verify equipment has bussing, capacity and actual space to allow addition of switches, circuit breakers and/or starters.

26 27 04. FEEDER CIRCUITS:

.1 SYSTEM DESIGN: Design feeders for a voltage drop of not more than 2 percent between terminals and capacity for 30 percent load growth above initial design, unless greater growth is designated by the University in the initial planning conference.

.2 FEEDERS: Feeder ratings shall not be such a large percentage of the main that coordination of time and current and interrupting capacities cannot be achieved.

.3 WIRING: All feeders be installed in full-weight rigid conduit, EMT may be used indoors for sizes 4" or less where the risk of physical damage is not a concern.

26 27 05. GENERAL PURPOSE POWER AND LIGHTING CIRCUITS: Voltage drop in branch circuits must be considered in design. Increase conductors a minimum of one size when 120 volt branch circuit home runs exceed 75-feet.

.1 LIGHTING CIRCUITS shall not be loaded to exceed 70 percent of panel breaker rating.

.2 SERVICE CIRCUITS: Not more than six unassigned general use duplex convenience outlets shall be on any one 20-ampere branch circuit, which includes prewired furniture, and lecture hall tables.

.2.1 Corridor receptacles shall not be connected to any adjacent room receptacles.

.3 BRANCH CIRCUIT PANELS: Panels for lighting, convenience outlets, small motors, and equipment shall be molded case circuit breaker type with thermal-magnetic trip and a-c and d-c ratings. Maximum number of poles shall not exceed

84. Provide spare circuits and spaces as noted in paragraph .3.3.1 below. Use of series rated equipment is prohibited.

.3.1 Breakers shall be 20-ampere, 1-pole breakers, mounted in the panel with bolted bus connections.

.3.1.1 Trip rating of breakers for lighting and general use convenience outlets shall be 20-ampere. Provide other sizes as required for special loads.

.3.2 Sub-Feed Breakers: Panels shall not have sub-feed breakers. If two panels are supplied from a long feeder, use sub-feed lugs or separate splice box with full size tap to panel mains.

Commentary: *No panel feeder shall feed more than an 84 pole panel.*

.3.3 When installing new branch circuit lighting panels on a project the following shall be considered:

.3.3.1 All new panel enclosures shall be minimum 30 poles for Lighting panels and 42 poles for Branch Circuit panels. Designers shall provide each new panel with a minimum of 15% spare 20 amp single pole circuit breakers and 15% spaces. Designers shall consider an additional panel when these minimums cannot be met. For all three phase-4 wire panels greater than 100 A the maximum load unbalance between phases shall not exceed 10%.

.3.3.1.1 Life Safety panels may be 12, 18, 24 or 30 pole where amount of load on panel is minimal.

.3.3.2 New panels shall be 200 Amp minimum for 208Y/120 volt, 3 phase, 4 wire service and 100 Amp minimum for 480/277 volt, 3 phase, 4 wire service. Do not provide 240/120 volt, 3 phase, and 4 wire tapped delta systems. Where 240 volts, 1 phase is needed, use buck/boost transformers as required.

. 3.3.2.1 Life Safety panels will be permitted to be a 100 amps or less depending on project requirements

.3.3.3 Any new or existing building with three-phase service shall only have three phase panels provided. All exceptions must be approved by the University Engineer.

.3.3.4 Do not provide panel feeders, fusing, or main circuit breakers at less than the panel main bussing rating.

.3.3.5 Branch circuits shall not be provided with shared neutrals regardless of what is existing in the facility.

.3.3.6 Where multiple branch circuits pass through a single box, all circuit breaker handles shall be provided with common tie, so all circuits will be taken out of service for servicing of the circuits.

.4 POWER PANELS shall be equipped with molded-case circuit breakers of adequate interrupting capacity

.5 ALL PANELS shall have silver plated copper bussing with full capacity neutral and ground busses.

.6 ALL PANELS shall have “Door-in-Door” front cover.

.7 Provide a dedicated 15 or 20 amp, 120 volt, single-phase circuit for each hand dryer shown on the drawings.

.8 Provide GFCI circuit breakers where required by N.E.C.

26 27 05. GENERAL PURPOSE POWER AND LIGHTING CIRCUITS:

.1 **Wexner Medical Center:** For any panelboard (existing that has been modified or new), contractors shall provide both hardcopy and electronic copy of OSUWMC panelboard legend standard (in Microsoft Excel format). Template can be provided by OSUWMC Facilities Services Department.

.1.1 Refer to Wexner Medical Center Special Requirements in 26 05 53.

26 29 00. LOW VOLTAGE CONTROLLERS

26 29 03. MOTORS AND MOTOR CONTROLS:

.1 RELATED WORK: Air-conditioning chiller starters and fire pump controllers shall be specified with the equipment in Divisions 23 and 21. Wiring from switchgear or switchboard to this equipment shall be specified in Division 26.

.2 NEMA AND NEC REQUIREMENTS:

.2.1 MOTORS AND MOTOR CONTROL EQUIPMENT shall conform to NEMA voltage ratings.

.2.2 MOTOR BRANCH CIRCUIT PROTECTIVE DEVICES shall meet the requirements of NEC 430.

.3 MOTOR CONTROL CENTERS: Class 1, Type C with terminal strip terminations.

.3.1 LOCATIONS: MCC’s shall not be located where ambient temperature could cause de-rating of overload devices.

.3.2 OVERLOAD HEATER CHARTS shall be furnished mounted inside doors of cabinets or separately framed and mounted outside the equipment.

.4 REDUCED VOLTAGE STARTERS: Motors, sizes shall be such that the inrush current exceeds 40 percent of the building transformer rating. Motors shall be equipped with reduced voltage starters of the closed transition autotransformer or

star-delta type, or solid-state soft start, or current ramp starters. For existing applications only, new construction shall use VFD.

.5 OPERATING PROTECTION:

.5.2 OVERLOAD RELAYS: Poly-phase motor controls shall be equipped with three bi-metallic overload relays. Reduced voltage starters shall provide overload protection during the starting step.

26 29 05. MOTOR STARTER APPLICATIONS:

.1 STARTERS RATED 7200V OR LESS shall conform to NEMA ICS3-2000, Part 1 and UL 347. This is a requirement for metal enclosed medium voltage motor controllers with fused power assemblies in a draw-out construction. Each motor controller shall be a complete self-contained Class E-2 Combination Starter, including disconnect means, main contactor, solid-state controller, and motor overload protection. Class E2 controllers employ their contacts for starting/stopping the motor and use fuses for short circuits or faults exceeding operating overloads. The contactor shall use vacuum as the interrupting means. The disconnect shall be a draw-out fuse carriage with Class R current limiting primary fuses for motor starting duty. Fuse and overload coordination shall be designed to allow the controller and contactor to clear low and medium level faults without opening and without exceeding the contactor interrupting ratings. Fuse assembly shall have a minimum short circuit rating of 50 kA symmetrical.

.1.1 STARTERS RATED 600V AND LESS shall conform to ANSI/NEMA ICS2-2000 (R2005). This is a requirement for magnetic controller ratings of 115-575V. AC Motor starters and contactors may be used for controlling the circuit to the motor. This standard requires that starters should be carefully applied on circuits and in combination with short-circuit protective devices such as circuit breakers that will limit the available fault current and let through energy level that the starter can safely withstand. This withstand must meet the requirements of ANSI/UL 508/2018, and ANSI/NEMA ICS 1-2000 (R2008) which cover controls, systems, and devices. Starters shall be minimum NEMA size 1. Use of IEC type components is prohibited.

.1.2 A padlockable non-fused disconnect switch shall be installed and located as close as possible to each motor. The use of a remote switch with lockout, at switchgear, switchboard, panel board or a unit in a Motor Control Center as the sole means of disconnecting the circuit is not permitted.

.1.3 All rooftop mounted equipment shall be provided with a local disconnect switch with NEMA type 3R enclosure.

26 30 00. FACILITY ELECTRICAL POWER GENERATING AND STORAGE EQUIPMENT

26 30 10. EMERGENCY POWER SYSTEMS:

.1 ALTERNATE POWER SOURCES: The University Master Plan provided for connecting groups of buildings with redundant power circuits for obtaining electric power supply to a building from alternate sources. Where the interruption of electric power supply to a building would result in hazard to life or property, major loss of research or equipment, provision shall be made for an emergency supply of power, to be used in the event of failure of the normal supply. Details of the plans as they apply to the project shall be explained and included in the early Design/Development submittal and conferences. If tie-in on existing circuit or feeder is not practical at present, provision shall be made for future tie-in. Emergency Power Systems are of two basic types:

A. An Electric Power Source set apart from the primary source of power operating in parallel that maintains power to the emergency loads should the primary source fail.

B. An available reliable power source to which emergency loads are rapidly switched automatically when the primary source of power fails.

.1.1 Not used

.1.2 Automatic Transfer Equipment: Reliable equipment and transfer switch must be specified.

.1.3 When emergency generators are specified, the A/E shall include requirements for acceptance load tests conducted under the supervision of a manufacturer's technical representative.

.1.4 Provide identification labels showing normal, emergency, and connected load sources along with building name and room numbers for any automatic transfer switches.

Commentary: *Identification labels shall provide the following information*:

A. Normal Service – source, building (if different then building in which automatic transfer switch is located) and room number Label shall be black with white lettering.

B. Emergency service – source, building (if different then building in which automatic transfer switch is located) and room number. Label shall be red with white lettering.

C. Emergency load - source, building (if different then building in which automatic transfer switch is located) and room number Label shall be red with white lettering.

D. **Wexner MEDICAL CENTER:** See Special Requirements in 26 05 53.

.2 Emergency and Standby Systems: It is required that provision be made by designing an emergency power system / standby power source supplied by:

A. Engine Generator

B. Separate Emergency Source

.2.1 Emergency electrical systems shall provide power to but not limited to the following essential electrical functions:

1. Life safety Illumination
2. Fire detection and alarm systems
3. Public Safety communications systems – ERRS -DAS
4. Processes where current interruption would produce serious life safety or health hazards

.2.2 Standby electrical systems shall provide power to but not limited to the following functions:

1. Elevators
2. Fire pumps
3. Essential Ventilating and smoke removal systems
4. Maintaining Business Continuity
5. Heating and Refrigeration systems
6. Communications systems
7. Sewage Disposal
8. Lighting (Other than exit/egress lighting)
9. Industrial processes.
10. Generators provided for dedicated lab equipment

.2.3. Circuit breakers provided with generators shall have provisions for padlocking in the open or closed position.

.2.3.1 Circuit breakers provided with generators shall be supplied with a set of NO/NC auxiliary contacts to indicate breaker position. These contacts shall be wired to the remote annunciator to indicate “alarm” if the breaker is left in the OPEN position.

.2.4 Emergency generator drives shall be evaluated on a project-by-project basis.

.2.5 The required generator remote annunciator monitoring panel shall be located next to the fire alarm remote annunciator panel or as required by Code. This main generator annunciator panel shall be labeled as “Primary Generator Annunciator Panel”. Any additional annunciator panels required shall be labeled as “Secondary Generator Annunciator Panel”. See Div 28 10 10 for additional requirements.

.2.6 Emergency generator fuel type shall be reviewed and evaluated with FOD Operations and approved by the University Engineer.

.2.6.1 New generator installations shall utilize diesel as a fuel source. Natural Gas (NG) is not permitted to power generators supplying Life Safety or Emergency loads, use of NG shall be evaluated on a project-by-project basis by FOD.

.2.6.2 Location of the generator shall be reviewed with the University Engineer, University Architect and University Landscape Architect to determine the best location. The University's preference is for the generator(s) to be placed at grade level.

Commentary: *Points to consider include but are not be limited to the following:*

A. Flood Plain

B. Esthetics

C. Grade Level

D. Maintainability

E. *Access for refueling*

.2.6.3 If the generator cannot be located at grade level the following provisions shall be provided:

A. A path from the generator shall be provided with conduit(s) and conductors to allow for connection to a future temporary generator. Provide a quick connect generator switchboard with quick connect cables of sufficient conductor length so that no additional conductors shall need to be provided.

B. Provide three 120-volt 20 amp circuits from an emergency source adjacent to the quick connect generator switchboard should a temporary generator need to be provided.

1. One circuit shall be for a temporary battery charger
2. One circuit shall be for a temporary block heater

C. Provisions shall be installed for connection to building automation system in the event a temporary unit is required to monitoring generator running signal.

D. An internal load bank shall be provided for all buildings where generators are not located at grade level. Provide load bank connection if at grade level.

E. A path and any required equipment (i.e. pumps, above ground tank, appropriate piping, etc.) for the filling of fuel for sub base or day tanks shall be provided when the diesel generator is not located at grade level.

F. Provide an automatic shutoff for the fuel line if fire is sensed at the tank.

.2.7 A/E shall only specify above ground, sub base or day tanks for fuel storage. Underground tanks are prohibited. A spill control kit shall be provided near any tank, See 2.5.5 for details.

.2.7.1 Storage tank fill pipe shall have a cap that shall accept a padlock. (Padlock shall be furnished by the University)

.2.7.2 Above ground tanks placed outdoors shall be placed inside secured screened areas. Location of tanks shall be approved by the University Architect and University Landscape Architect in consultation with the University Engineer.

.2.7.3: The above ground tanks shall be either of the following:

A. Double walled construction or

B. Located in a secondary containment curb that can contain entire (110% if outdoors) tank contents.

.2.7.4 The A/E shall ensure that the University Project Manager is provided with information relative to any fuel storage tank and the tank installation. University project manager shall share this information with Ohio State University - Environmental, Health and Safety group.

.2.7.5 Spill control kits shall be stored in a 20 gallon yellow drum and contain the following items as a minimum:

- One (1) Gallon of Super absorbent (ENSORB(R) or equal)
- Six (6) 42” socks
- Fifty (50) 15” x 20” absorbent pads
- Two (2) pairs of Nitrile Gloves
- Two (2) pairs of Goggles
- Two (2) 18” X 30” disposable bags and ties
- One (1) emergency response guide
- One (1) Instruction Sheet and Safety Data Sheets

.2.8. Contract Documents shall include the following in addition to any other requirements of the code.

A. Proper distances shall be provided from buildings, property lines, pedestrian traffic, building air intakes, and storm outlets.

B. Spill control shall be included via either double wall or secondary containment.

C. Above grade tanks shall be installed inside a secure screened area that is lockable and approved by the university Architect.

D. Provide permanently placed bollards for vehicular barrier protection.

E. An overfill prevention mechanism alarm monitoring system shall be provided

F. Provide a spill container to capture overfill at the fill connection locations.

G. Storage tanks shall be grounded

H. Feed lines shall be engineered to be protected from rupture and corrosion.

I. Fire extinguisher and weather resistant cabinet.

J. Emergency Power Off (EPO) pushbutton shall be separately mounted in an intuitive location. For outdoor installations the EPO shall not be mounted on the generator enclosure.

.2.9 Generators shall not be cooled using “Potable water”.

.2.10 Generator battery chargers and block heaters shall be connected to an emergency power panel.

.2.11 Emergency lighting shall be included at the generator location, in all mechanical equipment spaces, and in electric transformer and switchgear or switchboard spaces. Substation lighting and receptacles shall be included on the emergency system. Outdoor generator enclosures shall include a battery backed up lighting source.

.2.12 Electrical Equipment fed from an emergency generator or any two sources shall be tagged with a red label and white lettering.

A distinctive warning sign shall be provided indicating the location of both sources of power.

Commentary: *Signage at an automatic transfer switch may be similar to the following:*

NORMAL SERVICE – MAIN SWITCHBOARD MSB IN LOCATED ROOM 7M INTHIS BUILDING

EMERGENCY SERVICE - EMERGENCY SWITCHBOARD ESB LOCATED IN ROOM 35M IN THIS BUILDING

EMERGENCY LOAD LOCATED IN ROOM 10M IN MATH TOWER.

2.13 Generator batteries

A. Batteries shall be maintenance free heavy duty type.

B. Provide sufficient capacity for 1.5 minutes of total cranking time without recharging being required.

C. Provide the following items as required:

.1 Battery rack, cables, clamps and removable cover

.2.14 Battery Chargers:

A. Battery chargers shall be current limiting type and shall recharge the batteries automatically.
F. Charger shall be provided with charger/battery failure alarm and dry contacts output to generator controller.

.2.15 Environmental Considerations

.2.15.1 The engine shall be EPA-certified with an accessible and readable nameplate. Provide complete documentation that the engine meets all US EPA requirements. A copy of this documentation needs to be provided to the project manager for transmittal to Ohio State University -EHS.

.2.15.2 Provide specifications for the emergency generator to the university project manager to furnish to Ohio State University - EHS. Ohio State University - EHS will obtain the necessary permit-by-rule (PBR) for the generator from the Ohio EPA.

.2.15.3 Show location and specifications for the exhaust from the emergency generator. Ohio State University has specific Building Design Standards relating to rooftop exhaust stacks. See Appendix V

.2.15.4 Batteries shall be located such that any potential leakage is contained and any supporting structure/concrete will not be damaged.

.2.16 A/E shall include commissioning requirements in the project manual.

.2.17 On site load testing of emergency generators

.2.17.1 Provide a minimum of two hour on site load test after generator is installed.

.2.17.2 The generator will be tested the first half hour at 50% load

.2.17.3 The second half hour shall be tested at 75% load.

.2.17.4 The final hour of testing will be at 100%.

.3 EMERGENCY PANELBOARDS shall be provided for:

.3.1 Communications systems used for emergency purposes and mass notification systems.

.3.3 Fire alarms, building security equipment, and fire protection systems; this does not eliminate the need for batteries. Batteries shall be tested to indicate amp-hour availability. The Manufacturer shall provide documentation that indicates conformance with repaired rating to the University.

.3.4 Elevators and/or elevator rooms when required by Ohio Building Code.

.3.5 Traffic signals fed from the building (from the Equipment Branch only).

.3.6 EMERGENCY ILLUMINATION: Emergency illumination shall include all required means of egress lighting, exit signs, stairwell lighting, and all locations where code required minimum illumination must be provided to allow easy and safe egress from the area involved.

.3.7 **WEXNER MEDICAL CENTER**: Consult OSUWMC Facilities Engineering for additional requirements.

.4 WIRING FOR EMERGENCY SYSTEMS shall be in separate conduits.

.4.1 Switches for emergency lighting circuits shall not be accessible to the public.

.5 TRANSFER SWITCHES:

.5.1 In addition to the two sources feeding the automatic transfer switch, provisions shall be provided so that equipment, on the load side of automatic transfer switch, can be locked-out-tagged-out.

.5.2 All new and existing buildings being provided with generators shall be have dedicated automatic transfer switches installed for both the emergency and standby distribution systems.

.5.2.1 For health care or similar projects where critical and life safety emergency systems are provided, bypass-isolation switches shall be included.

.5.3 Transfer switches shall be UL 1008 listed, contactor type, electrically operated using a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions. Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

.5.3.1 Where four-pole switches are required, a true four pole switch shall be supplied, with all four poles mounted on a common shaft.

.5.3.2 Use of three pole switches shall be reviewed with the University Engineer.

.5.4 Existing buildings where emergency and standby systems are not on separate transfer switches shall be provided with new transfer switches to accommodate new emergency and/or standby loads being provided by the project.

.6 EXISTING GENERATORS

Commentary: *Each existing generator will need to be looked at on a project-by-project basis. Many of the existing university generators are currently at rated load or over rated load and will not be able to accommodate any new loads.*

.6.1 Existing capacities will need to be reviewed with the University to determine if the generator can serve any new loads.

.6.1.1 Projects requiring generator power shall have an "Emergency Power Request" form completed and submitted to FOD for consideration.

.6.2.2 No new loads may be added to an existing generator without an approved "Emergency Power Request" form completed and submitted to FOD for consideration.

.7 TEMPORARY SOURCE OF POWER FOR MAINTENANCE OR REPAIR OF THE EMERGENCY GENERATOR

.7.1 For buildings with a single generator serving life safety loads, a permanent switching means shall be provided to connect a portable or temporary generator to the building for the duration of the downtime to comply with NEC 700.3(F); a 3-way manual transfer switch can be used for this purpose.

.7.2 The 3-way manual transfer switch shall consist of (3) mechanically-interlocked molded case circuit breakers, male cam-style inlet connectors, female cam-style outlet connectors, power distribution blocks and grounding terminals, all housed within a padlockable enclosure to connect a portable generator or loadbank.

.8 **WEXNER MEDICAL CENTER**: EMERGENCY POWER SYSTEMS:

.8.1 Emergency power generators shall utilize diesel fuel engines.

.8.2 See MEDICAL CENTER Special Requirements in 26 05 53.

.8.3 Emergency Power Supply Systems (EPSS's) in critical care environments shall consist of N+1 power generation redundancy and utilize paralleling switchgear to provide increased reliability. Consideration shall also be given to the use of uninterruptible power supply (UPS) for critical and life safety branches of the emergency power system to eliminate switching interruption. External maintenance bypasses shall be provided to allow for removal and preventative maintenance of any UPS.

.8.4 Emergency generator electronic control systems shall be monitored via building automation system. Provide Ethernet jack in emergency generator locations to allow for connection to BACnet Ethernet backbone.

.8.5 EPSS fuel system shall also be monitored via building automation system. If dry contact indications are furnished with daytank and main fuel tank monitoring systems, provide connection to building automation system.

.8.6 Consideration shall be given quantity of transfer switches and respective loads to allow for load shedding in circumstances of emergency power system diminished capacity.

.8.7 Transfer switch control panels shall be provided with communications package to allow real time monitoring. Transfer switches shall be monitored via building automation system. If needed, protocol gateways shall be provided to convert generator protocol information to BACnet protocol (e.g., Modbus to BACnet). Provide Ethernet jack in transfer switch locations to allow for connection to BACnet Ethernet backbone.

.8.8 Delayed transfer switches shall have capability of "0 seconds" transfer time between normal and alternate sources. Those switches with minimum 1-second delay time are not acceptable.

.8.9 Transfer switches shall be open transition and of the bypass isolation type to enable servicing of equipment without shutdown. All bypass-isolation handles/controls shall be externally mounted and not require access into the enclosure for operation. Switches shall be capable of manual operation under load and be quick-make, quick-break. The switch shall have the capability of being fully manually operated and not be dependent upon electrical operators, relays or further interlocks for safe operation.

26 35 33 MOTOR MOUNTED POWER CAPACITORS

.1 Power Factor Correction: Motors (drives) 50 HP and larger shall be provided with fused, switched, power factor correction capacitors, one capacitor per phase, sized to correct to 100 percent or greater. It is preferred that the units be connected between the contactor and overload coils. Units shall meet all fire codes and be environmentally safe.

.1.1 Power capacitors shall be UL 810 labeled and factory wired ready for field connection with factory installed discharge device.

.1.2 Power capacitors shall be factory wired ready for field connection with factory installed discharge device.

26 37 00. ELECTRICAL PROVISION FOR ELEVATORS

.1 WIRING AND SWITCHING: Wiring shall be extended to fused switches located in elevator room.

.1.1 Provide shunt trip devices where elevator shafts are sprinklered.

.2 EMERGENCY CIRCUITS: A fused single phase disconnect switch powered from an emergency circuit shall be located in the Machine room to feed the lights and a GFCI receptacle; this circuit shall feed no other loads.

.3 PIT INSTALLATIONS: Coordinate with Division 14 requirements. Light fixtures, light switch and GFCI convenience outlet shall be provided in the pit of each elevator, each on separate circuits. If a sump pump is required for the elevator pit, then the sump pump shall be provided with a dedicated circuit and single receptacle without GFI.

.3.1 Light fixtures in the pit area shall be arranged so that a minimum of 20 FC is provided at any point in the pit.

.4 Where an elevator is equipped with a battery lowering device the main disconnect switch shall be supplied with auxiliary NO/NC contacts wired to allow the power to be turned off for maintenance.

.5 Where an ATS is part of the system, additional contacts shall be provided to indicate switch position and signal before transfer in either direction.

26 40 00. ELECTRICAL AND CATHODIC PROTECTION

26 41 00. FACILITY LIGHTNING PROTECTION:

.1 Each building shall be considered individually to determine the necessity for lightning protection. Lightning Risk Assessment calculations as noted in NFPA 780 Annex L shall be performed and submitted to the University through the project manager for review as well as the University's insurance carrier.

.1.1 If it is deemed necessary to provide the lightning protection system for the facility, then the A/E shall design and specify a traditional Franklin type system that meets Underwriter Laboratory's Master Label Certification program. The A/E shall engage a certified Lightning Protection Designer for this purpose.

.1.2 If it is decided that lightning protection is not necessary, this decision shall be made a matter of record. A listing of the people consulted shall be included in the conference memos along with "RISK" calculations noted above.

.1.3 All existing lightning protection system shall be maintained during building renovations and extended to any additions to the building and re-certified at the completion of the work.

.1.4 Any new and modified existing systems shall have UL Master Label "C" Certificate submitted to the University.

.1.5 Copy of UL Master Label certificates shall be given to the University Engineer and posted to the UL website.

.1.6 Original certificate shall be framed and located next to fire alarm panel

.1.7 Copies of certificate shall also be included in Operations and Maintenance Manuals.

.1.8 This standard requires that lightning/surge arresters be installed as close as possible to the HV/MV terminals of the Power Transformer and all other equipment requiring surge protection be grouped as close as possible to the arresters. Use the station type arrester for the best protective level and highest surge discharge ability for important and critical installations. The intermediate class type arrester shall be used for less critical installations and mostly for feeder protection.

A. Grounding network resistance shall not exceed 5 Ohms (5Ω). Lower values are preferred.

B. Ground Conductors: The surge arrester grounding conductor shall be connected into the common ground bus. The grounding conductor shall be run as directly as possible between the arresters and ground and be of low impedance and ample current carrying capacity. (See Section 26 20 06.2.4). These requirements must comply with National Electrical Code. (ANSI/NEMA 81-1990 (19, Article 190-193)).

C. Indoor locations: Arresters that are installed inside the buildings shall be enclosed or shall be located well away from passageways and combustible parts.

D. Installation: This standard requires that arresters must be located and installed in such a manner that the expulsion of gales or the arrester disconnect is not directed upon energized parts.

1.9 All protective lightning rods used for building or facility protection must have a UL Label affixed to them.

.2 GROUNDING SYSTEM REQUIREMENT: Because of possibility that a breakdown in grounding insulation may accidentally energize all plant or facilities, this Standard requires that ground connections shall be made to the electrode by methods providing the required permanence and ampacity, such as:

.2.1. A permanently effective non-reversible clamp, or exothermic weld.

.2.1.1 Connections at test wells shall be of the reversible type.

.2.2. All non-current carrying metallic structures or steel frame building are grounded.

.2.3 UFER type grounding electrode system.

.2.4 The main purpose of grounding system is as follows:

.2.4.1. To maintain low potential difference between metallic parts, ensuring freedom from electric shocks to personnel in the area.

.2.4.2. To avoid fires from volatile materials and ignition in combustible atmospheres by providing an effective electric conductor system for the flow of ground fault currents and lightning. The connection between the grounding electrode and the earth should have a resistance less than 5 ohms.

.3 SURGE PROTRECTION DEVICES:

.1 Surge Protective Devices installation shall be coordinated with lightning protection system in buildings so equipped.

.2 Surge Protective Devices, Type 1, shall be provided at service entrance equipment of all new facilities. For existing buildings undergoing electrical renovation or upgrading, SPD's shall be retrofitted to existing service entrance equipment.

.3 Surge Protective Devices shall be provided on the load side of all Transfer Switches per NEC requirements.

.4 If integrated, cascaded surge protection is needed at a facility, additional devices may be placed at downstream equipment.

.5 Surge current capability per phase shall be:

.5.1 Service Entrance: 300 kA.

.5.2 ATS, Distribution Panelboards and MCC's: 200 kA.

.5.3 Branch Circuit Panelboards: 100 kA.

26 42 00. CATHODIC PROTECTION

.1 UNDERGROUND PIPING: Cathodic protection method when such protection is determined to be appropriate. A/E shall retain the services of a Consultant specializing in Cathodic Protection System design.

26 50 00. LIGHTING

.1 LIGHT LEVELS-GENERAL: All new lighting installations shall comply with Ohio Building Code chapter 10 for emergency lighting requirements and chapter 13 for

energy efficiency requirements. Lighting levels shall meet current IES Standard recommendations.

1.1.1 Utility Tunnels: Provide 2 foot-candles minimum with fixtures spaced 20' to 25' apart down the center of the tunnel on the ceiling. Provide vapor tight ceiling mounted fixtures using LED illumination with appropriate globes and wire guard. Use fiberglass conduit with PVC boxes for tunnel lighting.

26 51 00. INTERIOR LIGHTING

.1 RECOMMENDED FIXTURES: LED fixtures with dimming are required.

.1.1 INCANDESCENT LIGHTING shall not be used. Incandescent lighting may be used only with the written permission of the University Engineer. Any department requesting approval of incandescent lighting must be willing to accept financial responsibility for the maintenance of the incandescent lighting. Where incandescent lamps are used as part of an equipment system or alarm, provide a minimum of 12 or 10% (whichever is greater) spare lamps of each wattage.

.1.2 MERCURY VAPOR lamps shall not be used. Exceptions, for research applications, must be submitted by the A/E for reviewed and approved by the University Engineer.

.1.3 METAL HALIDE lamps shall not be used.

.1.4 FLUORESCENT FIXTURES shall not be used. Exceptions for research applications must be submitted by the A/E for reviewed and approved by the University Engineer.

.1.5 QUARTZ LAMP FIXTURES shall not be used.

.2 Specify the use of exit signs utilizing Light Emitting Diodes (LED) light source with life expectancy greater than (10) ten years.

.3 LIGHTING SAFETY: Stairwells in buildings shall have sufficient fixtures so that the loss of one fixture will not leave the area dark. The mounting of the fixtures shall not be at the extreme height but must be accessible for maintenance. Position fixtures only on walls over landings at a minimum height of seven (7) feet to the bottom of the fixtures and a maximum height of eight (8) feet to the top of the fixtures. Fixtures shall have lenses. Lighting in stairwells shall not be manually switched. Provide occupancy sensors to reduce lighting levels in stairwells when unoccupied but maintain a minimum of 1 foot candle per OBC.

.4 All submittal reviews for lighting fixtures shall include the following:

A. Catalog cut sheets.

B. Lists of spare parts with quantities to be furnished.

C. A copy of each approved submittal and a copy of each signed receipt shall be included in the Operation and Maintenance Manuals.

.5 Fixture whips shall be made up of either #12 conductors in ½" flexible conduit minimum or #12 type MC Cable minimum.

.1 MC cable shall be provided with green grounding conductor.

.2 If cable ties are used for support then they must be UV stable cable ties.

.3 Fixture whips below ceilings may be provided with as cords similar to type "ST" rated 600 volts provided the following are met.

.3.1 Limit one cord per fixture.

.3.2 Do not daisy chain fixture cords for exposed fixtures.

.3.3 ST cord shall be provided with green grounding conductor

.3.4 Cord shall not be extended above ceiling other than into outlet boxes

.3.5 Cords are made up of #12 conductors minimum

.3.6 Cords longer than six feet are properly supported

.3.7 If cable ties are used for support then they must be UV stable.

.6 **WEXNER MEDICAL CENTER:** INTERIOR LIGHTING

.1 Battery powered emergency egress lighting, when used, shall be self- diagnosing type (momentary monthly testing and 90 minute annual test). Consideration shall be given to an inverter capable of handling multiple remote heads for those areas with multiple battery powered egress fixtures (e.g., mechanical or emergency power distribution rooms)

.2 Provide brushed aluminum type housing for exit signs.

.3 Operating rooms and Procedure rooms lighting control

.4 Patient rooms with reading and general lighting shall interface with nurse call system. Both general and reading lights shall be controlled individually via both nurse call paddle and room entry momentary toggle switches. Locate relays at room entrances to avoid interference with patient if service is required.

.5 Corridor, waiting area and lobby lighting in patient care areas shall be controlled from nurse station at a minimum.

26 56 00. EXTERIOR LIGHTING

.1 LIGHTING FOR THE ENTIRE SITE, INCLUDING DRIVEWAYS, WALKS, PARKING AREAS, and THE BUILDING PERIMETER shall be included in the contract documents.

.2 FIXTURES: LED fixtures mounted on the building or on suitable standards are required for all exterior site lighting. These fixtures shall be automatically controlled by photocell(s) for a "dusk on dawn off" operation. Lighting output shall be reduced per ASHRAE 90.1 requirements for exterior lighting. Campus standards are linked below for reference. Referenced fixtures are the basis of design. Approved equals

are allowed as approved by the University Engineer, University Landscape Architect, and University Architect. More details about exterior lighting or lighting poles may be obtained from Ohio State University Facilities Operations and Development website at https://fod.osu.edu/resources, click on “Design” tab in Vendor Resources.

.2.1 Light Control shall be provided on all exterior lighting fixtures. The fixture shall be insect proof. Vandal proof fixtures shall be used if the fixtures are mounted 10 feet or less off the ground.

.2.2 Lighting Fixtures with Wi-Fi capabilities. (*Reserved for Future*)

.3 FIXTURE LOCATION: Fixtures shall be located in such a manner that dark voids and excessive glare in windows are eliminated. Accessibility for servicing must be considered in locating fixtures. Consideration must also be given to light spillage onto adjacent facilities (existing or planned) such as greenhouses, which are light sensitive. Use directional or shielded lighting as necessary. Check with the University Engineer for the type of lights. Grounding rods shall be installed in all lighting poles.

.4 Outdoor Lighting Levels shall be designed as follows:

.4.1 Primary Walkways and problem areas - 2 foot-candles (FC) average and .5 FC minimum.

.4.2 Secondary Walkways and other areas - 1 FC and .25 FC minimum.

.4.3 Primary Streets - 2 FC average and .25 FC minimum.

.4.4 Parking Lots - 1 FC average and .25 FC minimum.

.4.5 High Activity outdoor parking areas shall be determined by the University Parking Advisory Committee.

.6 Run all three phase legs and neutrals to lighting standards and fuse each pole individually. Alternate each pole to different phase legs and balance phases. Conductors used for outdoor lighting shall be full color insulation for the designated voltage. Color tape for conductor identification is not an approved means of identification.

.7 Taps inside poles shall be insulated and molded for precise fit. Connectors with removable access plugs over hex screws... These connectors shall not require cover and taping. Connectors shall be abrasion and chemical resistant and also be UV rated. Connectors shall be rated for 600 volts, 90 degrees C. Split bolt connectors are not acceptable.

.8 The University has no secure storage. Any existing poles, luminaires, concrete collars or screw-in bases removed for relocation at a later date must be stored off campus at the project’s expense or in the project‘s staging area. Luminaires shall be removed prior to pole removal and stored indoors. Any items, except for luminaires, being turned over to the University shall go to the University designated storage location. Contractor shall coordinate storage location with Ohio State University project manager.

.9 All exterior lighting poles shall be provided with color coded tag as noted on the University website. Tags will identify pole number, power source and circuit number and will be color coded to distinguish phase of power source.

.11 When installing the gullwing poles, provide Quazite box adjacent to pole and provide #10 wire from feed into pole base. Fusing shall be accessible from pole base.

.12 Any conductors removed for outdoor lighting and not being reused shall be turned over to the University. Coordinate storage location with University Project Manager.

26 58 00. LIGHTING CONTROL

.1 AUTOMATIC SWITCHING: All spaces shall comply with the latest currently adopted version by the State of Ohio of ASHRAE 90.1. All spaces shall have automatic lighting off. Spaces where safety is a concern shall be exempt from automatic shutoff of fixtures. Exterior fixtures shall dim to meet ASHRAE 90.1 exterior requirements.

MULTIPLE SWITCHING: The use of multiple switching shall be evaluated for each space and condition. Where possible, switching shall be circuited to effectively use natural lighting from windows; to permit light reduction during partial occupancy; and to permit reduced lighting for custodial activity.

OCCUPANCY SENSORS shall not be used as the sole means of switching. Manual switches will be provided in all areas with occupancy sensors be limited to areas where automatic on control is allowed per ASHRAE 90.1 requirements. All occupancy sensors shall be dual-technology.

VACANCY Sensors shall be used in all locations where automatic on control is prohibited per ASHRAE 90.1 requirements.

.1.2 Multi- compartment restrooms shall be provided with at least one night light.

.2 REMOTE SWITCHING by means of a central control shall only be evaluated for new construction and for large renovation projects. Stand alone or networked lighting control systems in existing buildings shall have renovation work match existing lighting control manufacturer.

.3 DIMMING CONTROL: Dimming shall be used to meet the ASHRAE 90.1 requirements for lighting level steps between full on and full off.

.3.1 A distributed relay lighting control system with low voltage switches and 0-10V dimming controls is recommended for all general-purpose areas. DMX and DALI are also approved lighting control solutions to spaces. All other systems must be reviewed and approved by the University Engineer.

.3.2 All lighting control solutions shall have a ten years warranty.

.3.3 Lighting control systems shall be integrated into the Building Automation System. See FOD Appendix A 2.03.K for requirements.

.4 PARKING RAMP INTERIOR LIGHTING shall be circuited to permit lighting of dark interior areas during the day without lighting those areas that receive sufficient natural light. Automatic control of ramp lighting by photocell is required.

.5 ALL EXTERIOR AREA AND SECURITY LIGHTING shall be “dusk on and dawn off”, powered from one location in the building, and controlled from the photo control, with provisions for manual override. Time clock control shall not be used on exterior or security lighting. Exterior lighting shall be reduced per ASHRAE 90.1 requirements unless determined to be a safety or security concern.

END OF DIVISION 26 – ELECTRICAL